In the Claims

Claims are amended as follows:

1 to 30. (canceled)

31. (previously presented) A method of routing an information packet over a label switched path (LSP) between first and second end stations in a virtual private network (VPN) defined over a network arrangement of routers, the method comprising the step of:

attaching to the information packet at a network edge a sequence of labels indicative of a hierarchical arrangement of levels of paths, wherein a lowermost level of said hierarchical arrangement comprises a mesh of Layer 1 LSPs between adjacent routers, a next higher level of said hierarchical arrangement comprises a mesh of Layer 2 LSPs, each Layer 2 LSP comprising a concatenated sequence of Layer 1 LSPs, and wherein said LSP between the first and second end stations comprises an uppermost level of said hierarchical arrangement being specified by a pair of the Layer 2 LSPs;

wherein the hierarchical arrangement of levels of paths comprises a hierarchical arrangement of Quality of Service (QoS) capable Multi-Protocol Label Switch (MPLS) tunnels.

32. (previously presented) A method as claimed in claim 31, wherein each layer 2 LSP is a dynamic multiplex (DM) LSP.

33. (previously presented) A method as claimed in claim 32, wherein each Layer 2 LSP comprises a concatenated sequence of Layer 1 LSPs between a network edge router and a network central router.

34. (previously presented) A method as claimed in claim 33, wherein each network edge router comprises a local label switched router (LSR) and each central router comprises one of an international LSR node and a national tandem LSR.

35. (previously presented) A method as claimed in claim 33, wherein the pair of Layer 2 LSPs specifying the LSP between the first and second end stations comprises a first Layer 2 LSP between a network edge router serving the first end station and a central router and a second Layer 2 LSP between said central router and a network edge router serving the second end station, said central router connecting the two Layer 2 LSPs to form the LSP between the first and second end stations.

36. (previously presented) A method as claimed in claim 35, wherein the LSP between the first and second end stations comprises a session dynamically multiplexed onto said first and second Layer 2 LSPs, said session being switched between the first and second Layer 2 LSPs at the central router.

37-39. (canceled)

40. (previously presented) A method as claimed in claim 31, wherein the sequence of labels comprises four labels.

41. (previously presented) A method as claimed in claim 40, wherein the four labels include a label for a first Layer 2 LSP, a label for a second Layer 2 LSP, where said first and second Layer 2 LSPs specify the LSP between the first and second end stations, and a label for a first Layer 1 LSP from a network edge router serving the first end station to an adjacent router in the router network hosting the VPN.

42. (previously presented) A method as claimed in claim 31, wherein the Layer 1 and Layer 2 LSPs are established through one of RSVP Traffic Engineering Protocol and Constraint-Routed Label Distribution Protocol.

43. (previously presented) A method of forming an end to end label switched path (LSP) for packet transmission between first and second end stations in a virtual private network (VPN) defined over a network arrangement of routers, the method comprising the steps of:

establishing as a first, lower level in a hierarchical arrangement of levels of LSPs a mesh of Layer 1 LSPs between adjacent routers;

establishing as a next, higher level in said hierarchical arrangement a mesh of Layer 2 LSPs, each Layer 2 LSP comprising a concatenated sequence of Layer 1 LSPs;

specifying a pair of said Layer 2 LSPs as the end to end LSP between the first and second end stations, said end to end LSP comprising an uppermost level in said hierarchical arrangement; and

attaching to each packet to be transmitted over said end to end LSP a sequence of labels indicative of the hierarchical arrangement of levels of paths,

wherein the hierarchical arrangement of levels of LSPs comprises a hierarchical arrangement of Quality of Service (QoS) capable Multi-Protocol Label Switch (MPLS) tunnels.

44. (previously presented) A method as claimed in claim 43, wherein each layer 2 LSP is a dynamic multiplex (DM) LSP.

45. (previously presented) A method as claimed in claim 44, wherein each Layer 2 LSP comprises a concatenated sequence of Layer 1 LSPs between a network edge router and a network central router.

46. (previously presented) A method as claimed in claim 45, wherein each network edge router comprises a local label switched router (LSR) and each central router comprises one of an international LSR node and a national tandem LSR.

47. (previously presented) A method as claimed in claim 45, wherein the pair of Layer 2 LSPs specifying the end to end LSP between the first and second end stations comprises a first Layer 2 LSP between a network edge router serving the first end station and a central router and a second Layer 2 LSP between said central router and a network edge router serving the second end station, said central router connecting the two Layer 2 LSPs to form the LSP between the first and second end stations.

48. (previously presented) A method as claimed in claim 47, wherein the end to end LSP between the first and second end stations comprises a session dynamically multiplexed onto said first and second Layer 2 LSPs, said session being switched between the first and second Layer 2 LSPs at the central router.

49-51. (canceled)

52. (previously presented) A method as claimed in claim 43, wherein the sequence of labels comprises four labels.

53. (previously presented) A method as claimed in claim 52, wherein the four labels include a label for a first Layer 2 LSP, a label for a second Layer 2 LSP, where said first and second Layer 2 LSPs specify the LSP between the first and second end stations, and a label for a first Layer 1 LSP from a network edge router serving the first end station to an adjacent router in the router network hosting the VPN.

54. (previously presented) A method as claimed in claim 43, wherein the Layer 1 and Layer 2 LSPs are established through one of RSVP Traffic Engineering Protocol and Constraint-Routed Label Distribution Protocol.

55. (previously presented) A method of forming an end to end label switched path (LSP) for packet transmission between first and second end stations in a virtual private network (VPN) defined over a network arrangement of routers, the method comprising the steps of:

establishing as a first, lower level in a hierarchical arrangement of levels of LSPs a mesh of Layer 1 LSPs between adjacent routers;

establishing as a next, higher level in said hierarchical arrangement a mesh of Layer 2 LSPs, each Layer 2 LSP comprising a concatenated sequence of Layer 1 LSPs;

specifying a pair of said Layer 2 LSPs as the end to end LSP between the first and second end stations, said end to end LSP comprising an uppermost level in said hierarchical arrangement; and

attaching to each packet to be transmitted over said end to end LSP a sequence of labels indicative of the hierarchical arrangement of levels of paths, wherein each layer 2 LSP is a dynamic multiplex (DM) LSP, wherein each Layer 2 LSP comprises a concatenated sequence of Layer 1 LSPs between a network edge router and a network central router, wherein the pair of Layer 2 LSPs specifying the end to end LSP between the first and second end stations comprises a first Layer 2 LSP between a network edge router serving the first end station and a central router and a second Layer 2 LSP between said central router and a network edge router serving the second end station, said central router connecting the two Layer 2 LSPs to form the LSP between the first and second end stations;

wherein the step of specifying a pair of Layer 2 LSPs as the end to end LSP between the first and second end stations comprises the steps of:

forwarding from a first media gateway associated with the first end station a number of candidate first Layer 2 LSPs to a second media gateway associated with

the second end station, said candidate Layer 2 LSPs extending between the network edge router serving the first end station and the central router;

at said second media gateway selecting one of a number of second Layer 2 LSPs, said selected second Layer 2 LSP extending between the central router and the network edge router serving the second end station; and

returning from said second media gateway to said first media gateway control information pertaining to the pair of Layer 2 LSPs selected to establish the end to end LSP between the end stations.

56. (previously presented) A method as claimed in claim 55, wherein the control information comprises a sequence of LSP-identifiers (LSP-IDs).

57. (previously presented) A method as claimed in claim 56, wherein the sequence of LSP-IDs comprises four LSP-IDs consisting of a LSP-ID for a path between the first media gateway and the network edge router serving the first end station, a LSP-ID for a path between said network edge router and the central router, a LSP-ID for a path between the central router and the network edge router serving the second end station and a LSP-ID for a path from said network edge router and the second media gateway.

58. (previously presented) A method as claimed in claim 56, wherein the network edge router serving the first end station uses said sequence of LSP-IDs returned by the second media gateway to define a label stack for each packet transmitted on the end to end LSP, wherein said label stack includes a label for a first Layer 2 LSP, a label for a second Layer 2 LSP, where said first and second Layer 2 LSPs specify said end to end LSP between the first and second end stations, and a label for a first Layer 1 LSP from said network edge router to an adjacent router in the router network hosting the VPN.

59. (previously presented) A method as claimed in claim 48, wherein a new session is multiplexed onto said first and second Layer 2 LSPs only if resource constraints of said first and second Layer 2 LSPs are satisfied.

60. (previously presented) A method of selecting a series of tunnels between a source edge label switched router (LSR) and a destination edge LSR to form an end to end label switched tunnel between said source and destination edge LSRs, said LSRs belonging to a network arrangement of LSRs, the network arrangement of LSRs including a plurality of network central LSRs, the method comprising the steps of:

at the source edge LSR determining resource availability by identifying a candidate list of first Layer 2 tunnels extending from the source edge LSR to any of the plurality of central LSRs, said first Layer 2 tunnels each comprising a concatenated sequence of Layer 1 label switched tunnels connecting adjacent LSRs in a mesh of LSRs including the source edge LSR, intermediate LSRs and the plurality of central LSRs;

forwarding the candidate list to the destination LSR;

at the destination LSR, identifying any second Layer 2 tunnels extending from any of the central LSRs to the destination edge LSR that satisfies a connection condition that the identified second Layer 2 tunnel meets one of said first Layer 2 tunnels at one of said central LSRs; and

selecting a pair of the Layer 2 tunnels, one from the candidate list of first Layer 2 tunnels and one of the second Layer 2 tunnels that satisfies the connection condition, to form an end to end label switched tunnel between the source and destination edge LSRs.

61. (previously presented) A method as claimed in claim 60, wherein each layer 2 tunnel is a dynamic multiplex (DM) LSP.

62. (previously presented) A method as claimed in claim 60, wherein the end to end tunnel between the source and destination edge LSRs comprises a session dynamically multiplexed onto said first and second Layer 2 tunnels, said session being switched between the first and second Layer 2 tunnels at the central LSR at which said Layer 2 tunnels meet.

63. (previously presented) A method as claimed in claim 60, wherein the Layer 2 tunnels comprise Multi-Protocol Label Switch (MPLS) tunnels.

64. (previously presented) A method as claimed in claim 63, wherein the Layer 1 tunnels comprise MPLS tunnels that have static reservation.

65. (previously presented) A method as claimed in claim 60, wherein the Layer 1 and Layer 2 tunnels are established through one of RSVP Traffic Engineering Protocol and Constraint-Routed Label Distribution Protocol.

66. (previously presented) A method as claimed in claim 62, wherein a new session is multiplexed onto said end to end tunnel only if resource constraints of said first and second Layer 2 tunnels comprising the end to end tunnel are satisfied.

67. (previously presented) A method as claimed in claim 60, wherein a label stack comprising a sequence of labels is attached to each packet transmitted on the end to end tunnel, said labels identifying at least the Layer 2 tunnels comprising the end to end tunnel.

68. (previously presented) A method as claimed in claim 67, wherein the sequence of labels comprises four labels.

69. (previously presented) A method as claimed in claim 68, wherein the four labels include a label for a first Layer 2 tunnel, a label for a second Layer 2 tunnel, where

said first and second Layer 2 tunnels specify the end to end tunnel between the source and destination edge LSRs, and a label for a first Layer 1 tunnel from the source edge LSR to an adjacent LSR in the LSR network.

70. (previously presented) A method as claimed in claim 60, wherein the destination edge LSR returns control information to the source edge LSR comprising a sequence of LSP-identifiers (LSP-IDs) identifying the pair of Layer 2 tunnels selected to form the end to end tunnel.

71. (previously presented) A method as claimed in claim 70, wherein the sequence of LSP-IDs comprises four LSP-IDs consisting of a LSP-ID for a path between a first media gateway and the source edge LSR, a LSP-ID for a path between said source edge LSR and a central LSR, a LSP-ID for a path between the central LSR and the destination edge LSR and a LSP-ID from said destination edge LSR and a second media gateway.

72. (previously presented) A method as claimed in claim 71, wherein the source edge LSR uses said sequence of LSP-IDs to define a label stack for each packet transmitted on the end to end tunnel, wherein said label stack includes a label for the first Layer 2 tunnel, a label for the second Layer 2 tunnel, and a label for a first Layer 1 tunnel from said source edge LSR to an adjacent LSR in the mesh of LSRs.

73. (previously presented) A system for forming an end to end label switched path (LSP) for packet transmission between first and second end stations in a virtual private network (VPN) defined over a network arrangement of routers, the system comprising:

a management system for establishing as a first, lower level in a hierarchical arrangement of levels of LSPs a mesh of Layer 1 LSPs between adjacent routers, said management system also establishing as a next, higher level in said hierarchical arrangement a mesh of Layer 2 LSPs, each Layer 2 LSP comprising a

concatenated sequence of Layer 1 LSPs, and specifying a pair of said Layer 2 LSPs as the end to end LSP between the first and second end stations, said end to end LSP comprising an uppermost level in said hierarchical arrangement; and

a network edge router associated with the first end station for attaching to each packet to be transmitted over said end to end LSP a sequence of labels indicative of the hierarchical arrangement of levels of LSPs;

wherein the hierarchical arrangement of levels of LSPs comprises a hierarchical arrangement of Quality of Service (QoS) capable Multi-Protocol Label Switch (MPLS) tunnels.

74. (previously presented) A system as claimed in claim 73, wherein the management system is arranged to form each layer 2 LSP as a dynamic multiplex (DM) LSP.

75. (previously presented) A system as claimed in claim 74, wherein the management system is arranged to form each Layer 2 LSP as a concatenated sequence of Layer 1 LSPs between the network edge router and a network central router.

76. (previously presented) A system as claimed in claim 75, wherein each network edge router comprises a local label switched router (LSR) and each central router comprises one of an international LSR node and a national tandem LSR.

77. (previously presented) A system as claimed in claim 75, wherein the management system is arranged to select the pair of Layer 2 LSPs specifying the end to end LSP between the first and second end stations as comprising a first Layer 2 LSP between the network edge router serving the first end station and a central router and a second Layer 2 LSP between said central router and a network edge router serving the second end station, said central router connecting the two Layer 2 LSPs.

78. (previously presented) A system as claimed in claim 77, wherein the management system is arranged to dynamically multiplex a session onto said first and second Layer 2 LSPs, said session being switched between the first and second Layer 2 LSPs at the central router, thereby forming the end to end LSP.

79. (canceled)

80. (canceled)

81. (canceled)

82. (previously presented) A system as claimed in claim 73, wherein network edge router is arranged to attach four labels to each packet.

83. (previously presented) A system as claimed in claim 82, wherein the four labels include a label for a first Layer 2 LSP, a label for a second Layer 2 LSP, where said first and second Layer 2 LSPs specify the LSP between the first and second end stations, and a label for a first Layer 1 LSP from a network edge router serving the first end station to an adjacent router in the router network hosting the VPN.

84. (previously presented) A system as claimed in claim 83, wherein the management system is arranged to establish the Layer 1 and Layer 2 LSPs through one of RSVP Traffic Engineering Protocol and Constraint-Routed Label Distribution Protocol.

85. (previously presented) A system as claimed in claim 83, comprising a first media gateway associated with the first end station for forwarding a number of candidate first Layer 2 LSPs to a second media gateway associated with the second end station, said candidate first Layer 2 LSPs extending between the network edge

router serving the first end station and the central router; said second media gateway being arranged to select one of a number of second Layer 2 LSPs, said selected second Layer 2 LSP extending between the central router and the network edge router serving the second end station, and to return to said first media gateway control information pertaining to the pair of Layer 2 LSPs selected to establish the end to end LSP between the end stations.

86. (previously presented) A system as claimed in claim 85, wherein the control information comprises a sequence of LSP-identifiers (LSP-IDs).

87. (previously presented) A system as claimed in claim 86, wherein the sequence of LSP-IDs comprises four LSP-IDs consisting of a LSP-ID for a path between the first media gateway and the network edge router serving the first end station, a LSP-ID for a path between said network edge router and the central router, a LSP-ID for a path between the central router and the network edge router serving the second end station and a LSP-ID for a path from said network edge router and the second media gateway.

88. (previously presented) A system as claimed in claim 86, wherein the network edge router serving the first end station uses said sequence of LSP-IDs returned by the second media gateway to define a label stack for each packet transmitted on the end to end LSP, wherein said label stack includes a label for a first Layer 2 LSP, a label for a second Layer 2 LSP, where said first and second Layer 2 LSPs specify said end to end LSP between the first and second end stations, and a label for a first Layer 1 LSP from said network edge router to an adjacent router in the router network hosting the VPN.

89. (currently amended) A system for selecting a series of tunnels to form an end to end label switched tunnel across a communications network comprising:

a router network including a source edge label switched router (LSR), a plurality of central LSRs and a destination edge LSR; wherein

said source edge LSR is arranged to determine resource availability by identifying a candidate list of first Layer 2 tunnels extending from said source edge LSR to any of the plurality of central LSRs, said first Layer 2 tunnels each comprising a concatenated sequence of Layer 1 label switched tunnels connecting adjacent LSRs in a mesh of LSRs including the source edge LSR, intermediate LSRs and the plurality of central LSRs, and to forward the candidate list to the destination LSR;

said destination LSR being ~~Sebring~~ arranged to identify any second Layer 2 tunnels extending from any of the central LSRs to the destination edge LSR that satisfies a connection condition that the identified second Layer 2 tunnel meets one of said first Layer 2 tunnels at one of said central LSRs; and to select a pair of the Layer 2 tunnels, one from the candidate list of first Layer 2 tunnels and one of the second Layer 2 tunnels that satisfies the connection condition, to form said end to end label switched tunnel between the source and destination edge LSRs.

90. (previously presented) A system as claimed in claim 88, wherein each layer 2 tunnel is a dynamic multiplex (DM) LSP.

91. (previously presented) A system as claimed in claim 88, wherein the end to end tunnel between the source and destination edge LSRs comprises a session dynamically multiplexed onto said first and second Layer 2 tunnels, said session being switched between the first and second Layer 2 tunnels at the central LSR at which said Layer 2 tunnels meet.

92. (previously presented) A system as claimed in claim 89, wherein the Layer 2 tunnels comprise Multi-Protocol Label Switch (MPLS) tunnels.

93. (previously presented) A system as claimed in claim 92, wherein the Layer 1 tunnels comprise MPLS tunnels that have static reservation.

94. (previously presented) A system as claimed in claim 89, wherein the Layer 1 and Layer 2 tunnels are established through one of RSVP Traffic Engineering Protocol and Constraint-Routed Label Distribution Protocol.

95. (previously presented) A system as claimed in claim 91, wherein a new session is multiplexed onto said end to end tunnel only if resource constraints of said first and second Layer 2 tunnels comprising the end to end tunnel are satisfied.

96. (previously presented) A system as claimed in claim 89, wherein the source edge LSR is arranged to attach a label stack comprising a sequence of labels to each packet transmitted on the end to end tunnel, said labels identifying at least the Layer 2 tunnels comprising the end to end tunnel.

97. (previously presented) A system as claimed in claim 96, wherein the sequence of labels comprises four labels.

98. (previously presented) A system as claimed in claim 97, wherein the four labels include a label for a first Layer 2 tunnel, a label for a second Layer 2 tunnel, where said first and second Layer 2 tunnels specify the end to end tunnel between the source and destination edge LSRs, and a label for a first Layer 1 tunnel from the source edge LSR to an adjacent LSR in the LSR network.

99. (previously presented) A system as claimed in claim 89, wherein the destination edge LSR is arranged to return control information to the source edge LSR comprising a sequence of LSP-identifiers (LSP-IDs) identifying the pair of Layer 2 tunnels selected to form the end to end tunnel.

100. (previously presented) A system as claimed in claim 99, wherein the sequence of LSP-IDs comprises four LSP-IDs consisting of a LSP-ID for a path

between a first media gateway and the source edge LSR, a LSP-ID for a path between said source edge LSR and a central LSR, a LSP-ID for a path between the central LSR and the destination edge LSR and a LSP-ID from said destination edge LSR and a second media gateway.

101. (previously presented) A system as claimed in claim 100, wherein the source edge LSR uses said sequence of LSP-IDs to define a label stack for each packet transmitted on the end to end tunnel, wherein said label stack includes a label for the first Layer 2 tunnel, a label for the second Layer 2 tunnel, and a label for a first Layer 1 tunnel from said source edge LSR to an adjacent LSR in the mesh of LSRs.